SIMULATION routine

("Monte Carlo Method")

Simulation of random phenomena, based on (pseudo-)random numbers

1) Define the phenomenon to simulate (random variable, x) and ***(a)*** caracterize it through an adequate probability function or ***(b)*** go to **2**.

DISCRETE VARIABLE	CONTINUOUS VARIABLE
Let $f(x)$ be the (point) probability function.	Let $f(x)$ be the probability density function.

2) Determine the cumulative (distribution) function.

DISCRETE VARIABLE	CONTINUOUS VARIABLE
$F(x) = \sum_{t=x_{\min}}^{x} f(t)$	$F(x) = \int_{x_{\min}}^{x} f(t)\,\mathrm{d}\,t$

($x_{\min}$ is the least value possible for x.)

Whenever the analytical form of $F(x)$ is unknown or difficult to deduce, it is necessary to tabulate $F(x)$.

3) Adopt uniform random numbers of k digits, with k "compatible" with the values of $F(x)$ to use (same number of significant digits).

(The value of k depends of the circumstances of the problem.)

4) *(Simulation proper)* Extract a random number, N, and divide it by 10^k, to obtain the random number u, reduced to the interval [0, 1).

$$u = N/10^k$$

5) Solve the equation " $F(x) = u$ " for x, i.e.,

DISCRETE VARIABLE	CONTINUOUS VARIABLE
$F(x-1) \le u < F(x)$ [with $F(x_{\min} - 1) = 0$] whence x is obtained.	$F(x) = u$ If the function F has a known inverse, $\tilde{F}$, $x = \tilde{F}(u)$

The value x is a simulated value of the random variable under consideration.

6) Return to the simulation procedure —steps **4** and **5**— until a "sufficient" number of values is calculated; or finish.

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